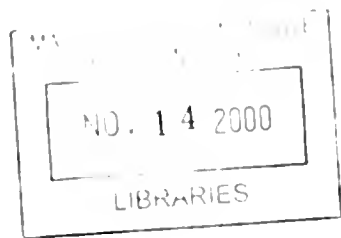A THEORY OF INEFFICIENT
INTRAFIRM TRANSACTIONS

Julio J. Rotemberg

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# A Theory of Inefficient
# Intrafirm Transactions *

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## Abstract

This paper presents a model in which goods market distortions lead firms to socially inefficient modes of internal organization. The model seeks to capture the aversion documented by Eccles and White (1988) of middle management aversion to inter-profit center transactions. I consider situations where reputational forces are able to support equilibria in which goods are of high quality. These forces can break down when the transactions take place within the firm. Integration may nonetheless be privately worthwhile if price exceeds marginal cost.

# A Theory of Inefficient
# Intrafirm Transactions

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Unrelated individuals work together within firms. Firms have rules governing the relationships of these individuals. Some individuals within the firm have authority, they decide what others should do and how much to pay them. They also decide what activities the firms lets outsiders carry out under contract.

At least since Coase (1937) economists have viewed these arrangements as adaptations which make profits higher than they would be otherwise. Obviously, this maximization of profits does not imply that the organization of firms maximizes the social good. The usual product market imperfections can lead firms to make money while providing a socially inefficient level of output. Authors concerned with the internal organization of the firm tend to ignore these imperfections. Perhaps for this reason the analysis of Coase (1937), Alchian and Demsetz (1972), Williamson (1985) and Grossman and Hart (1986) implies that the authority relations within firms are optimal from a social perspective.[1] Williamson (1985) goes so far as to state: "This book advances the proposition that the economic institutions of capitalism have the main purpose of economizing on transactions costs." In this paper I show that this optimistic appraisal is due at least in part to the exclusion of market imperfections. The inefficiencies associated with product market power can distort not only the level of output but also the transactions which make this level of output possible.

The basis for this paper is that the existence of goods market distortions implies that some firms earn monopoly rents. As a result, firms would willingly tolerate organizational

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[1] See the survey by Holmstrom and Tirole (1987) for additional references.

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inefficiencies if such inefficiencies help them capture these rents. Some of the economy's rents may be thus dissipated in the form of inefficient organization of production. Rent dissipation of this kind may help explain why conventional measurements of profits do not uncover a much monopolistic conduct.

The work of Eccles and White (1988) has influenced the particular inefficiency on which I focus. They interviewed managers who buy and sell goods across profit centers in multi-profit center firms. The impression left by these interviews is that managers prefer external to internal transactions. They would rather buy from and sell to agents outside the firm. Internal transactions occur at all because they are mandated by top management. Frictions are much more common in these mandated transactions than in their external counterparts. Eccles and White (1988) justly regard their findings as a challenge to Williamson's (1985) view of firms. Their evidence suggests that transactions costs actually increase when firms engage in internal transactions.

In the models I present below, sellers provide high quality when only spot markets are allowed. The reason they do so is that customers change suppliers whenever they have an unsatisfactory experience. Suppliers remain diligent because they are afraid of losing customers in this way. Customer mobility is essential for ensuring high quality.

Long term contracts which penalize the buyer when he changes sellers reduce this mobility. Mobility is also reduced if the buyer and seller integrate and the managers of the integrated enterprise mandate internal transactions. Whichever of these mobility reducing mechanisms is adopted, quality suffers. If a supplier cannot lose a particular customer he has little incentive to provide him with high quality goods.

If long term contracts and integration reduce quality, why do they arise? Such arrangements are attractive when price exceeds marginal cost. In this case, there is an advantage from reducing mobility. The reduction in mobility increases the overall rents earned by the buyer and seller.[2] They get to keep the difference between price and marginal cost only when the buyer remains attached to the seller.

The excess of price over marginal cost necessary to induce quality reducing associations

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[2] For other models in which socially inefficient contracts arise because they help capture rents see Aghion and Bolton (1987), Dewatripont (1988) and Ordover, Saloner and Salop (1988).

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between buyer and seller can be due to a variety of reasons. In the first model I explore it is the result of implicit collusion among finitely many price-setting firms. In my second model high prices are due to the presence of quantity setting firms which compete in Cournot fashion. I develop this model as well to show that my results do not hinge on the multiplicities inherent in supergame models.

Informational imperfections play a crucial role in my models. With perfect information about quality, contracts can force sellers to provide high quality. I assume instead that quality is observable but not verifiable by outsiders. Examples of quality which have this feature include the willingness of the supplier to work hard on the customer's behalf. In particular, the supplier can try to change delivery schedules and specifications to accommodate changes in the customer's needs. Alternatively, the supplier can insist on fulfilling only those obligations written into the contract.

The paper proceeds as follows. Section 1 considers a model of implicit collusion among sellers. In the first subsection I consider equilibria with spot markets only. These equilibria often exhibit high quality. Sellers provide good quality because buyers change suppliers when quality proves to be low. The formal model is very similar to Klein and Leffler (1981). It differs mainly in that I provide reasons for customers to leave after encountering low quality while they do not.

In the second subsection I consider long term contracts. These contracts reduce mobility by forcing the buyer to compensate the seller when he changes partners. This reduces the seller's fear of losing the buyer. This increases the rents of the seller at the cost of reducing quality. I provide conditions under which the optimal contract of this sort impedes all mobility and provides only bad quality goods.

In the third subsection I argue that outright integration can alleviate the low quality consequences of long term contracts. The idea is that quality becomes easier to verify if both the seller and the buyer come under the authority of a common boss. This boss can use his power to gather evidence on the quality of the goods that are provided. The availability of this evidence makes it possible to make compensation depend on quality. Therefore, suppliers can more easily be induced to furnish high quality goods. Top management,

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with a role similar to that in Alchian and Demsetz (1972), thus emerges endogenously in the model. Quality verification via integration costs resources. From a social point of view this method of improving quality is thus inferior to spot markets. Therefore, this subsection both explains why firms who transact internally are created and why these intrafirm transactions might be inefficient.

Section 2 then considers a model with Cournot competition among sellers. Again its first subsection deals with separate firms, the second with associated firms. Section 3 concludes.

## 1. Repeated Oligopoly

The upstream market consists of $N$ firms. The firms can produce a homogeneous intermediate good. They can then sell this good to a variety of customers. The marginal cost of a bad quality version of the good is $c$. This cost is the cost of compensating workers for the effort needed to produce the good. If their worker spends an additional effort which is worth $\epsilon$ to him, the good is, at least sometimes, of good quality. I assume that if the worker spends the requisite effort, the good becomes a high quality good with probability $\sigma$. With probability $(1 - \sigma)$, it remains a low quality good.

The downstream customers buy $Y$ units of the good. They are willing to pay $r$ for each unit of good quality. A unit of bad quality is worth $\mu$ less to them than a unit of good quality. They are risk neutral so that they are willing to pay $(r - x\mu)$ for a unit which is of low quality with probability $x$.

Contracts cannot specify the level of quality. This occurs because outsiders cannot observe quality so they cannot enforce contracts which stipulate payments as a function of quality. High quality thus includes the provision of services which, while not easy to stipulate, are important to the buyer. These services can include courteous service and prompt handling of complaints. High quality also includes the flexibility of the seller in meeting changes in the buyers needs. Suppose the buyer originally wrote a contract for delivery at the beginning of December. The buyer then realizes that he would much prefer delivery in the middle of November. A high quality seller is flexible so that he is capable of changing the delivery at a low cost. A seller of bad quality finds it very costly to change

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the delivery date. The courts see only the *ex post* cost of changes in deliver and not the effort made in being flexible.[3]

While payments cannot depend on quality, they can depend on the number of units transacted. Spot markets allow only this type of payment. Long term contracts also allow payments to take place when a buyer changes supplier. I consider these two institutional structures in turn.

## 1.1. Spot Markets

In the case of spot markets each purchasing transaction has three stages. First, all upstream suppliers announce their prices. Second, buyers and sellers sign a contract specifying how many units are sold at this price in the current period. Finally, delivery occurs either with low or high quality. Customers know what quality they have received. After receiving a good of either high or low quality the customer has the option of changing suppliers.[4]

Customers constantly update their beliefs about the quality offered by different suppliers. Before knowing current prices, customer $j$ assigns a subjective prior probability $z_{ij}$ to the event that firm $i$ is providing low quality. After observing the price $P_i$, the customer updates this prior as in Klein and Leffler (1981). She calculates a posterior probability $x_{ij}$ that low quality is being provided. The customer then computes $[r - (P_i + x_{ij}\mu)]$, the expected net surplus that she can obtain from supplier $i$. She purchases only from those suppliers with the highest net surplus.

The purchaser drops the previous period's supplier if he is not among those providing highest net surplus. In this case, she randomly picks one cheap supplier. Otherwise, she stays with her previous supplier. One difficulty with Klein and Leffler's original model is that there is never any equilibrium reason to either leave or stay with last period's supplier. Even if a particular supplier deviates from the equilibrium by supplying bad quality, there is no reason to suppose that he will supply bad quality in the future. His

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[3] This example of quality is very reminiscent of Grossman and Hart (1986). As will be clearer below, this moral hazard problem of the seller is not as easily solved by integration as those they consider.

[4] In Klein and Leffler (1981) customers who have received bad quality can also communicate this to other potential buyers. Including this possibility would not affect the analysis. It is excluded here because I stress below the difficulties in communicating the level of quality one has received to one's superior.

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incentives to provide good quality do not change after supplying bad quality. This difficulty is only compounded if one recognizes that, in practice, changing suppliers is costly to the customer. In the presence of such mobility costs, there is even less reason to leave a supplier particularly if the deficiency of quality might be due to bad luck.

To circumvent this difficulty, I introduce an equilibrium reason for customers to infer that it is worthwhile to leave suppliers whose quality is low. I assume that firms can be in one of two regimes. In the usual regime they are well managed. In other words they take the actions which maximize profits. Sometimes, however, firms are badly managed. When firms are in this bad regime they provide only bad quality. In other words, badly managed firms fail to give their employees the necessary incentives to assure good quality.

I assume that well managed firms randomly become poorly managed. They then tend to remain poorly managed. In particular, well managed firms are less likely to become poorly managed than poorly managed firms are to remain so. Formally, I capture these ideas by letting firms be in two states. Well managed firms are in state $w$ while poorly managed firms are in state $b$. The probability that a well managed firm remains well managed in the next period is $(1 - \phi)$. The probability that a poorly managed firm becomes well managed is $(1 - \psi)$. I assume that $\psi$ exceeds $\phi$ so that bad management has a tendency to persist.

These transition probabilities imply a steady state probability of being in state $w$ equal to:

$$P(w) = \frac{1 - \psi}{1 + \phi - \psi}. \tag{1}$$

To capture the idea that firms are essentially always well managed, I assume that $\phi$ is almost equal to zero. Indeed, the analysis is simplest when one takes the limit as $\phi$ goes to zero. For simplicity I also assume that the initial probability of being in state $w$ is the same as the steady state probability (1).

Supplying firms do not observe each other's quality. They do however observe each other's prices. I assume below that firms can follow pricing strategies which depend on prices charged earlier. As is typical of supergames, there are many possible equilibria. The outcome depends on customer's beliefs about quality as well as on supplier reactions to

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other firms' prices.

The worst equilibrium for suppliers has customers believing that bad quality is always provided. As long as $(r - \mu) > c$, there is then an equilibrium where all active suppliers charge c and provide bad quality. For a producer to deviate by either providing good quality or lower prices represents a simple gift to customers. For him to deviate by raising his price loses him all sales.

Equilibria reminiscent of Klein and Leffler (1981) have customers initially believe that all suppliers who charge relatively high prices try to provide good quality. Because price is high, managers then do try to provide high quality. There are generally several equilibria of this kind. They differ in the price charged by firms. Equilibria with higher prices actually have a bigger incentive to provide high quality. At these equilibria firms lose more when customers leave unhappy with the quality they have received. Sellers also prefer the equilibria with higher prices. Thus, if they can meet *ab initio* and agree on an equilibrium they would pick the one with the highest price. These considerations lead me to focus on this particular equilibrium.

At this equilibrium, sellers try to supply good quality. Since the unconditional probability that firms are well managed is $\frac{1-\psi}{1+\phi-\psi}$, the probability that a buyer choosing a seller at random obtains a good of high quality is $\frac{(1-\psi)\sigma}{1+\phi-\psi}$. Therefore, the most a customer is willing to pay to a firm chosen at random is:

$$r - \left(1 - \sigma\frac{1-\psi}{1+\phi-\psi}\right)\mu. \tag{2}$$

It only makes sense for the firms to focus on high quality equilibria with this price if this strategy is more profitable than one of providing low quality. The highest price firms can obtain while offering low quality is $r - \mu$. The higher price in (2) makes it worthwhile to attempt to provide high quality if $\frac{(1-\psi)\sigma\mu}{1+\phi-\psi}$ exceeds the cost of attempting to provide high quality. I show below that, when the firms are well managed, this cost equals $\epsilon$ on average. Since badly managed firms do not incur this cost, the average cost from sustaining the quality implicit in (2) is $\frac{(1-\psi)\epsilon}{1+\phi-\psi}$. Thus the attempt to provide quality is worthwhile as long as $\sigma\mu$ exceeds $\epsilon$.

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I now show that, under some additional conditions, there is an equilibrium where firms charge the price given by (2) and try to provide high quality. To do this, I first consider customer behavior in the presence of this price when customers believe that sellers are doing their best. I prove that customers come back to sellers who have given them high quality while they desert those that haven't. Then, I consider seller behavior. I show that it is not in the interest of sellers to deviate from this price and from the attempt to provide high quality.

Suppose a customer receives high quality from a seller in period $t$. He thus concludes that the seller is currently well managed. His probability of obtaining high quality next period from this particular seller is thus $\sigma(1-\phi)$. By contrast, his probability of obtaining high quality from a seller chosen at random is only $\frac{(1-\psi)\sigma}{1+\phi-\psi}$. This latter term is smaller whenever, as I have assumed, $\psi$ exceeds $\phi$. He therefore finds it in his best interest to remain with his old seller.

Suppose instead that the customer receives low quality in period $t$. What probability does he now assign to having a badly managed seller? This probability depends on his prior probability of having a badly managed seller. By the argument of the paragraph above, this prior probability is highest if the customer has bought a high quality good from this particular seller at $t-1$. I thus consider this case first.

Let $b_t$ represent the event that the seller is badly managed at $t$ while $L_t$ represents the event that he provides low quality at $t$. Then, the probability of event $b_t$ given that the seller was previously well managed and that he provides bad quality at $t$ is:

$$P(b_t|L_t, w_{t-1}) = \frac{P(b_t, L_t|w_{t-1})}{P(b_t, L_t|w_{t-1}) + P(w_t, L_t|w_{t-1})}$$
$$= \frac{\phi}{\phi + (1-\sigma)(1-\phi)}. \tag{3}$$

This probability exceeds the probability $\frac{\phi}{1+\phi-\psi}$ that a firm chosen at random is poorly managed as long as:

$$\sigma \geq \frac{\psi - \phi}{1 - \phi}. \tag{4}$$

In other words, as long as well managed firms are sufficiently likely to produce high quality, customers abandon suppliers who suddenly sell low quality. If (4) is met buyers

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leave even those sellers with which they have been previously successful. If equation (4) is satisfied, customers who have previously received good quality leave when quality becomes bad. What about customers which have not received a good quality unit in the past from this seller. Consider in particular buyers who have had no experience with this seller because they have just changed suppliers. Their prior probability that the seller is well managed is then only $\frac{1-\psi}{1+\phi-\psi}$. The probability that he is badly managed given that he has provided bad quality is:

$$
\begin{aligned}
P(b_t|L_t) &= \frac{P(b_t, L_t)}{P(b_t, L_t) + P(w_t, L_t)} \\
&= \frac{\phi}{\phi + (1 - \sigma)(1 - \psi)}.
\end{aligned} \tag{5}
$$

This probability always exceeds the probability $\frac{\phi}{1+\phi-\psi}$ that a firm chosen at random is poorly managed. The customers who have just arrive always leave a supplier who gives them bad quality. In conclusion, when (4) is met, all buyers leave firms who offer low quality.

I now turn to seller behavior. I show that, given that consumers leave those who provide bad quality, sellers find it in their best interest to supply good quality. I later turn to sellers' incentives to change prices.

To offer good quality, a seller must provide appropriate incentives to his workers. I assume that the seller does not observe quality directly. A well managed seller, however, can offer his worker a contract which makes compensation depend on whether a particular purchaser comes back next period. I assume workers are risk neutral but that it is impossible to pay them less than $c$ in any time period.[5] I let $I_0$ be the amount the worker is paid if the customer does not come back while $I_1$ is the amount he gets when the purchase is repeated. For the worker to try to provide high quality the following conditions must be met:

$$
I_0 + \sigma I_1 \geq c + \epsilon \tag{6}
$$

$$
\sigma(I_1 - I_0) \geq \epsilon \tag{7}
$$

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[5] Liquidity constraints of this type have very similar implications to risk aversion but are much easier to analyze. The more usual assumption that it is only necessary to pay them a nonnegative amount complicates the analysis without affecting the conclusions.

Condition (6) requires that the worker earn on average the value of their effort. Condition (7) is necessary for workers to be willing to work hard in the hope of providing good quality. If income cannot be less than $c$, the lowest cost method for satisfying these conditions is to let $I_0$ equal $c$ while $I_1$ equals $c + \frac{\epsilon}{\sigma}$.

I now ask whether a currently well managed seller wants to deviate from an equilibrium where he is providing incentives for high quality. Suppose in particular that he neglects to provide these incentives just in the current period. He then loses all his current customers. In the future he regains some customers who become dissatisfied with their current suppliers. To consider a single deviation in isolation I suppose that the supplier does attempt to give these later customers good quality.

By deviating in this manner, the supplier avoids the cost $\frac{\epsilon}{\sigma}$ of compensating the workers for their extra effort. Naturally, he only incurs this cost if the quality effort is successful and customers return in the following period. So, whenever he incurs this cost he also gains $\delta(P - c)$ where P is the price charged and $\delta$ is the discount factor. Using (2), the net gain over the next period is:

$$\sigma \left\{ \frac{\epsilon}{\sigma} - \delta \left( r - c - \left[ 1 - \frac{\sigma(1 - \psi)}{1 + \phi - \psi} \right] \mu \right) \right\}. \tag{8}$$

One additional gain from deviating and providing low quality is that one can avoid paying for the effort needed to produce high quality for the customers who return in the next period. Once again this is offset by the fact that such payments only occur when customers are returning a second time. The net gains from the avoidance of effort inducing payments in the next period are thus proportional to (8). Given this proportionality, these deviations are worthwhile if (8) is positive. By contrast, firms are happy to try to provide quality as long as (8) is negative and:

$$r - c - \left[ 1 - \frac{\sigma(1 - \psi)}{1 + \phi - \psi} \right] \mu - \frac{\epsilon}{\sigma \delta} \geq 0. \tag{9}$$

All that is necessary for (9) to hold is that the willingness to pay $r$ be sufficiently large.

I now consider seller deviations in the price that they charge. I assume that any such change in price is observable by competitors. It is viewed by them as well as by customers

as a violation of the collusive understanding. Therefore all the customers as well as the firms expect that, one period after the deviation price will fall to $c$ and quality will be low. Since this deviation reduces profits to zero from next period on, firms will refrain from such deviations as long as they do not discount the future too severely. There is an additional reason why this deviation is unattractive to sellers. Because it leads all to expect bad quality for the future, it eliminates all firms' (including the deviator's) incentive to provide high quality in the current period. Thus the deviator can only sell low quality goods at relatively low prices even in the current period.[6]

This section has demonstrated that, when only spot contracts are possible, equilibria with high quality often exist. These equilibria are in principle even possible when a common agent owns the assets used by buyer as well as the assets of a seller. However, in this case this common owner has to let the buyer change suppliers every time he receives bad quality.

When buyers and sellers' assets are owned by separate agents, these high quality equilibria are quite plausible. They tend to be more profitable to implicitly colluding sellers than equilibria with lower quality. One problem (from the seller's perspective) with these equilibria is that buyers often sever their relationship with their seller. They usually do so because their seller has ben unlucky and has been unable to produce good quality in spite of trying. Only very seldom are these separations useful in that a buyer is separating from a seller who is not trying to produce high quality goods. Indeed, in the limit where $\phi$ goes to zero, all separations are the result of mistakes.

## 1.2. Long Term Contracts

I now consider the possibility of long term contracts. In particular, there is an initial period before any sales take place. In this initial period, a particular buyer and a particular seller can write such a contract. For simplicity I assume that this particular buyer buys one unit per period. The long term contract stipulates not only a price paid for the good but also stipulates payments that must be made if the buyer changes sellers. The purpose of this contract is to reduce the number of accidental separations which are so ubiquitous when only spot contracts are allowed. This is advantageous to the seller because it allows

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[6] The punishments I consider I obviously extreme. However, the analysis of Friedman (1971) makes it clear that milder punishments are generally sufficient to deter changes in observable prices.

him to capture more rents. The sellers is thus willing to compensate the buyer in exchange for reducing his mobility.

The precise amount by which the seller compensates the buyer in the contract that is actually written depends on the relative bargaining power of the two agents in the initial period. Suppose the seller can make a take-it-or- leave-it offer which, if rejected, leads to the sequence of spot contracts analyzed in section 1.1 Then, the buyer will give little to the seller. The opposite is true if the buyer gets to make a take-it-or-leave-it offer. Naturally, the alternating offers scheme of Rubinstein (1982) gives an intermediate answer.

Independently of whose bargaining power is larger, the arrangement is likely to be efficient if bargaining is done under complete information. In other words, the arrangement is likely to maximize the sum of buyer and seller profits. Then, the degree of bargaining power will determine the distribution of these profits.

From the perspective of the sum of both profits, the principal issue is the response of the buyer when he receives low quality. In particular, I let $\lambda$ be the probability that the buyer comes back to the seller after receiving bad quality. The spot market contracts considered in section 1.1 had $\lambda$ equal to zero. By contrast a completely binding long term commitment to buy from this seller would have a $\lambda$ equal to one. To implement the intermediate cases, the buyer must be made indifferent between staying and leaving after receiving low quality. This indifference can be accomplished by forcing the buyer to pay damages whenever he abandons the relationship.

There are two effects from increases in $\lambda$. The first is an increase in rents to which I return shortly. The second is that high quality becomes more expensive. As before I assume that the level of quality is not contractible. What can be made part of the contract is the pattern of payments to the seller's worker. To induce him to exert effort the contract must specify that he gets paid more when the buyer returns than when he doesn't. Once again, let $I_0$ be the worker's payment if this buyer changes suppliers while $I_1$ is his payment if he doesn't. These payments must both exceed $c$. Because this customer returns with probability $\lambda$ even when quality is low, the analogues to (6) and (7) are now:

$$I_0 + (\sigma + [1 - \sigma]\lambda)I_1 \geq c + \epsilon \tag{6'}$$

$$\sigma(1-\lambda)(I_1 - I_0) \geq \epsilon \qquad (7')$$

Given that $I_0$ cannot be lower than $c$, the lowest cost method for satisfying these constraints is to let (7') hold with equality. This implies that $I_1$ equals $c + \frac{\epsilon}{\sigma(1-\lambda)}$. Therefore, average payments to the worker when he is induced to provide high quality equal:

$$W = c + \frac{\sigma + (1-\sigma)\lambda}{\sigma(1-\lambda)}\epsilon. \qquad (10)$$

These payments are strictly increasing in $\lambda$. Increases in $\lambda$ essentially raise the probability that the worker gets $I_1$ even when he does not engage in effort. This reduces his incentive to work. To reestablish his desire to work, the difference between $I_1$ and $I_0$ must increase. Since $I_0$ cannot fall, this requires an increase in $I_1$. This increase is particularly expensive because $I_1$ is also sometimes paid when the effort is unsuccessful in producing high quality.

Because quality becomes more expensive as $\lambda$ increases, it is not obvious that contracts with high values of $\lambda$ involve high quality. I thus analyze first the optimal $\lambda$ if the two parties attempt to maintain high quality and then the optimal $\lambda$ when they don't. Of these two contracts, the optimal one is the one with higher joint profits. For simplicity in computing these contracts I now consider only the limit where $\phi$ is zero.

If the buyer ever leaves the seller, he starts buying at a price of $[r - (1-\sigma)\mu]$. The good that he buys is worth $[r - (1-\sigma)\mu]$ to him. He thus receives no further surplus. Similarly, the seller receives no surplus from this buyer once he leaves. By contrast, joint profits whenever the buyer actually purchases from the seller are, on average:

$$r - (1-\sigma)\mu - W. \qquad (11)$$

Since the buyer remains with probability $[\sigma + (1-\sigma)\lambda]$, we can write overall joint profits using (10) and (11) as:

$$\left[\frac{1}{1 - \delta[\sigma + (1-\sigma)\lambda]}\right]\left[r - c - (1-\sigma)\mu - \frac{\sigma + (1-\sigma)\lambda}{\sigma(1-\lambda)}\epsilon\right]. \qquad (12)$$

Assuming an interior solution, the optimal $\lambda$ therefore ensures that the derivative of (12) with respect to $\lambda$ is zero:

$$\frac{\delta(1-\sigma)}{(1 - \delta[\sigma + (1-\sigma)\lambda])^2}\left[r - c - (1-\sigma)\mu - \frac{\sigma + (1-\sigma)\lambda}{\sigma(1-\lambda)}\epsilon\right]$$
$$- \frac{\sigma + (1-\sigma)\lambda}{\sigma(1-\lambda)^2}\epsilon = 0. \qquad (13)$$

The term on the first line of (13) captures the fact that an increase in $\lambda$ raises the revenues of the seller by reducing separations. The one on the second line captures the increased costs of quality which result from higher values of $\lambda$. Note that the optimum is interior only if the expression in (13), evaluated at $\lambda$ equal zero, is positive. Otherwise the optimal $\lambda$ is zero and the buyer and seller are no more attached than in a spot market.

Note also that the optimal $\lambda$ given by (13) is strictly smaller than one. A $\lambda$ of one makes the expression in (13) infinitely negative. Given the second order conditions, this means that reductions in $\lambda$ are profitable. The reason a $\lambda$ equal to one is unprofitable here is that it makes it infinitely costly to provide high quality.

The alternative solution is not to provide quality.[7] This gives overall profits for the two firms equal to:

$$\left[\frac{1}{1 - \delta[\sigma + (1 - \sigma)\lambda]}\right] [r - c - \mu]. \tag{14}$$

The expression (14) is strictly increasing in $\lambda$. Once quality is abandoned the two agents have everything to gain by remaining together. They thereby avoid giving rents to the other sellers.

To obtain the optimal contract we must compare the expression (14) with $\lambda$ equal to one with the expression (12) with $\lambda$ given by the solution of (13). If the former is larger, the two firms give up quality and never separate. If the latter is larger, the two firms do separate probabilistically.

I do not have closed form expressions which determine the outcome that will prevail. However, it is clear from (12), (13) and (14) that, if $(r - c)$ is sufficiently big the firms give up high quality. A high $(r - c)$ means that the rents from any sale are large. This means that the firms have much to lose by separations. They will therefore very much prefer to let separations be extremely rare. However, the rarer are the separations, the higher is $\lambda$ and the more expensive is the provision of quality. Thus, when firms are very averse to separations, they make do with low quality.

Two numerical examples illustrate these points. Both these examples have $\mu$ equal to

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[7] I am assuming that the quality provided to the buyer who has a long term contract does not affect other buyers' beliefs about the quality they will receive. This is consistent with the absence of communication among buyers assumed so far. Even if I allowed such communication, outsiders would not be surprised to learn that bonded customers receive worse treatment. There would be no reason to update the likelihood of receiving good quality on the basis of the quality provided to those buyers.

one, $\delta$ equal to .9 and $\sigma$ equal to .75. In the first example $\epsilon$ is relatively small in that it equals .3. Therefore, the social gain from providing quality ($\sigma\mu - \epsilon$) is a relatively large .45. For sellers to provide quality with spot contracts condition (9) must be met and ($r - c$) must exceed .4. Otherwise the surplus they get from future sales does not justify the provision of current quality.

Even when long term contracts (which render $\lambda$ positive) are available, they are not always chosen. Indeed, for ($r - c$) between .4 and 1.13 the firms prefer to let $\lambda$ equal zero. When rents from customer attachment are relatively low it is not worth either increasing the cost of quality (by having an interior $\lambda$) or foregoing quality completely. For ($r - c$) between 1.13 and 1.2 the buyer and seller choose a strictly positive $\lambda$ which is below one. Quality remains high but its cost is higher. For ($r - c$) above 1.2 the incentive to capture rents is so large that they choose to let $\lambda$ equal one and give up on high quality.

In the second example $\epsilon$ equals .5 so the social gain from quality is smaller and equals only .25. Provision of quality with spot contracts now requires that ($r - c$) equal at least .99. Even a buyer and seller who have access to long term contracts choose spot markets when ($r - c$) is between .99 and 1.11. For larger ($r - c$) the optimal contract forgoes quality altogether. Not surprisingly, as the social value of quality falls, the firms become more eager to give up quality in exchange for capturing rents. What is interesting is that in this example where the social benefit of quality is relatively low it is never optimal to have a strictly positive $\lambda$ below one. As ($r - c$) increases the optimal contract jumps from having $\lambda$ equal zero to having $\lambda$ equal one.

At this point it is worth digressing on what would happen if the worker was not subject to moral hazard. Suppose that, unlike the case I have considered, the seller can always bring forth the effort that brings about high quality with probability $\sigma$ by paying $\epsilon$ to the worker. Now suppose that the contract specifies that the buyer leaves this seller with probability $\lambda$ when he receives low quality. The higher is $\lambda$, the higher are the seller's rents. Also, the higher is $\lambda$ the less the seller wants to provide high quality. With low $\lambda$ the seller wants to spend $\epsilon$ to keep his customer but with high $\lambda$ the customer comes back anyway. So, in a sense, the moral hazard of the worker is inessential. As soon as the seller

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is assured of the buyer's business, he feels little desire to provide quality.

On the other hand, without worker moral hazard, there exists an empirically unappealing but theoretically viable solution to the quality problem. This solution involves writing contracts with a third party. The contract specifies that the seller must pay the third party some large sum if the buyer changes supplier. The buyer, on the other hand must also make payments to a third party if he moves. The payments by the buyer ensure that he is indifferent between moving and not moving after receiving low quality. This indifference is necessary for $\lambda$ to be positive. The payments from the seller to the third party make the seller very keen on keeping the customer happy. They thus ensure that seller tries to improve quality.

In practice, we do not observe such third party contracts, probably because they are subject to a moral hazard of their own. After the contract is signed the third party and the buyer have an incentive to gang up against the seller. Rather than pursuing this line of argument I have chosen instead to let the seller's worker be subject to moral hazard directly. With this worker moral hazard, third parties cannot help to resolve the quality problem.

In this section I have shown that the buyer and seller will sometimes like to be joined by a long term contract which eliminates high quality. Since this contract does not affect the number of units purchased its only substantive effect is the reduction in quality. This has a social cost of $(\sigma\mu - \epsilon)$.

The way to understand the results of these two sections is the following. With potentially repeated spot market purchases it is possible to support socially desirable equilibria with high quality. If long term contracts are then permitted, in particular if firms do not punish each other for entering such contracts, the provision of high quality may become impossible.[8] Long term contracts have at least the potential for reducing the efficiency of transactions.

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[8] The analysis implies that any buyer and seller who have access to long term contracts act in the same way. Thus when such a contract is attractive to one buyer-seller pair all spot markets disappear as soon as we let all buyers and sellers sign these contracts. In practice, heterogeneity among buyers will only make the contracts attractive to some.

## 1.3. Outright Integration

Section 1.2 has shown the benefits of long term contracts and their potentially adverse impact on quality. However, the motivation for the paper is the low quality of intrafirm transactions. In this subsection I argue that outright integration is probably useful when the buyer and seller decide to write a contract with $\lambda$ equal to one. In such contracts, the buyer is completely bound to the seller and quality is very low. In such circumstances it becomes worthwhile to attempt to employ other mechanism for assuring high quality. One natural mechanism of this type requires that both buyer and seller come under the authority of a common employer.

Before showing that integration can be useful it is worth stressing some things it cannot do. First, unlike Grossman and Hart (1986)[9] giving control to either the buyer or the seller does not, by itself, solve the quality problem. In Grossman and Hart (1986) these changes of control help because they change the payoffs to both parties from some project they have in common. Here, seller control would solve the seller's moral hazard problem if the seller could thereby receive the buyer's payoff. The seller would try hard to provide quality if he himself gained $\mu$ when quality is high. By contrast, I have in mind a situation where a separate agent who buys is needed even when the seller has control. That buyer has to incur personal costs equal to $\mu$ if quality is low. Seller control of the joint enterprise does not change the identity of the person incurring the costs of low quality. Thus, seller control does not, by itself, reduce the costs of providing quality. For this reason I focus on common ownership by a third party rather than on buyer or seller control.

Second, common ownership does not, by itself, make it easier for the seller to provide the requisite effort. Because top management must pay sellers more for high quality and compensate buyers for receiving bad quality both agents have an incentive to lie. The seller would like top management to believe that he is spending the effort necessary to provide good quality. The buyer would like top management to believe that she must exert herself to undo the consequences of the bad quality she is receiving. Management cannot ascertain quality on the basis of their words alone.

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[9] See also the version of their model in Holmstrom and Tirole (1987).

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Finally, suppose that top management can ascertain quality by the expenditure of some resources. This is still not sufficient to solve the problem. The essence of my earlier assumption is that contractual payments cannot depend on the level of quality even though this level of quality is observed by buyers. The idea is that, for payments to depend on the level of quality, outside courts must be able to verify its presence. It is not enough for top management to know whether quality has been provided.

There is nonetheless one mechanism which can help the top management of a common company induce high quality. Suppose that by spending $V$, top management discovers whether quality has been provided in a way which is later verifiable at no cost. After $V$ is spent, there exists objective evidence on quality which an outside court can use. Then spending $V$ every period is worthwhile after a contract with $\lambda$ equals one has been signed if:

$$V < \sigma\mu - \epsilon. \tag{15}$$

After $V$ is spent, quality is contractible. This means that management can offer to pay the selling worker $\frac{\epsilon}{\sigma}$ when he is successful in providing quality. This makes the effort worthwhile for the worker. When (15) is satisfied these payments to the worker as well as the expenditure of $V$ is worthwhile to a combination of buyer and seller which refuses to separate under any circumstances.

When (15) is satisfied, it is sometimes worthwhile to make $\lambda$ equal to one when, in the absence of this monitoring technology, the optimal $\lambda$ is smaller. The reason is that now the buyer and seller gain the rents from eliminating all separations without sacrificing as much. Thus, the presence of this technology encourages integration under common management. It also encourages this common management to order the in-house buyer to buy from the in-house seller whenever this is feasible. From a social point of view such integration wastes $V$ since high quality can be achieved without any monitoring.

Thus, in my favored interpretation of my results intrafirm transactions are excessively common. Society would be better off if more transactions took place through the market.

The role of top management in this subsection is to spend $V$ collecting evidence on

quality. Management is the monitor as in Alchian and Demsetz (1972).[10] As in the study of Eccles and White (1988), management settles disputes over quality.[11] They show that, in transactions between profit centers, disputes arise and top management acts as the arbiter. I interpret these disputes as disputes over the quality actually provided.

The resources spent on verifying quality (the role of management that I stress) can take many forms. The work of Eccles and White (1988) suggests that these resources often take the form of conflict between buyers and sellers. Managers encourage these fights because they reveal information. Buyers and sellers presumably dislike these fights. Their wages must compensate them for this utility loss. It is difficult to imagine wages depending on the actual number and intensity of fights. It is more likely that pay depends only on the average, or expected, level of conflict. Then, both buyers and sellers will be averse to any increased conflict. They will both route transactions externally whenever they can. The aversion to internal transactions on the part of both buyers and sellers is amply documented in Eccles and White (1988).

One issue which arises at this point is why the $V$ that is spent on verifying quality must be spent by the top management of a common firm. Why, for instance, can't these resources be spent by outside auditors or even by the courts? There are two reasons. The first, and principal, reason is that monitoring, policing and verification require power. The monitor must be able to change the conditions of production to find out how the seller and buyer are actually behaving. This flexibility is essential precisely because it is difficult to predict in advance the form of high vs. low quality. Therefore the monitor must be in a position to dictate how the assets with which buyer and seller work are used. Such residual control over the use of assets virtually defines the role of top management. Indeed, from a legal point of view, such residual control is the purview of the owner of the asset.[12]

The second reason for having top management perform the verification is that such verification is considerably simplified if one is familiar with both buyer and seller. Obtaining this familiarity takes time. There is thus a benefit to having the monitor remain

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[10] Their model assumes there is a technological reason for monitors. As a result the monitoring that emerges is socially good, if not inevitable. By contrast, the monitoring that takes place here could usefully be replaced by a market.

[11] This arbiter role is also stressed by Williamson (1975).

[12] Grossman and Hart (1986) equate residual control over the use of assets with ownership.

in his job for a long time. By making the monitor part of the firm, one increases his mobility costs and thereby one ensures that he learns the personal characteristics of buyer and seller.

The shortcomings of long term contracts and the advantages of mergers that I describe are similar to those of the "incomplete contracts" theory of the firm surveyed by Holmstrom and Tirole (1987). As in that literature, some individuals are put in charge because contracts cannot specify all contingencies. These individuals get to decide how to proceed when the contract does not specify what is to follow.

Grossman and Hart (1986) also base their theory of the firms on contractual incompleteness. Yet, the implications of their model seem quite different from the one presented here. They focus on the contractual incompleteness which makes it difficult to pay individuals for the specific human capital that they get. In the absence of ownership rights, some of the benefits of an individual's human capital accumulation accrue to others. Ownership can ameliorate this. The owner gets to decide on all uncontracted transactions ex post. He therefore receives a disproportionate share of the payoff to both his and his underlings human capital accumulation. This alleviates the moral hazard problem inherent in the human capital accumulation of the owner. They are careful to present their model as one of an owner/manager. Perhaps their theory applies also to corporate top management. In this case one would expect top managers compensation to be closely related to firm performance.

In my story, by contrast, moral hazard may not be an issue for top managers. Top managers are policemen. The competence with which they dispatch these functions may be easy to determine from their reports. Top managers could still earn large sums if the skills needed to investigate wrongdoing, and apportion blame are in short supply. In this case, one would expect larger firms, whose policing problems are more complex, to hire more competent policemen. This suggests that management compensation should increase with firm size. By contrast their wages need not bear any particular relationship to firm performance. Jensen and Murphy (1988) suggest that compensation depends on firm size but rises only very slowly with firm performance.

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One critical question faced by all theories of the firm is the conundrum posed by Coase (1937) and Williamson (1985). The question is what limits firm size. If top managers can intervene selectively and obtain whatever advantages there are to integration a single firm should control the whole economy obtain. This argument gains additional force when we recognize that integration eases collusion in product markets.

Williamson (1985) gives a variety of reasons why managers cannot actually intervene so selectively. One reason which appears particularly germane in my context is that managers are imperfect and sometimes make mistakes. For managers to be effective at policing they must have great authority, so these mistakes can be costly. They become more costly the larger is the manager's span of control. Giving a manager residual decision rights over the assets used by many individuals when his decisions only rarely contribute to the common good is dangerous. By contrast, giving him these rights where intervention is needed often is more attractive.

The basic message of these three subsections is that firms may well disrupt their organizations to capture rents. This is probably true of many models where firms can earn such *ex post* rents in equilibrium. To show that it does not depend on supergames with their attendant multiplicity of equilibria I consider next a finite horizon model. There, given purchasers beliefs about quality, the equilibrium is unique.

## 2. A Cournot Model

I now consider a duopoly which is active for only two periods. The use of a finite horizon rules out the sort of supergame strategies which were central to the previous analysis. I now assume that the firms must initially invest simultaneously in capital. This capital gives them the capacity to produce in both periods. Production is then costless up to this capacity but it cannot exceed capacity.

In each period, both firms choose price simultaneously. If both firms choose the same price, they each sell the minimum of their capacity and half the quantity demanded at this price. If one firm has a lower price, it sells the minimum of its capacity and total demand at its price. The other firm's demand is obtained by shifting the overall demand curve horizontally. The extent of this horizontal shift is the amount sold by the firm with

a lower price. Aside from the issue of quality, the structure of duopolistic interaction is as in Kreps and Scheinkman (1983). Therefore, for a given level of quality, capacities equal their Cournot levels.

In a finite horizon model it is more difficult to sustain quality with the threat that customers will leave when offered bad quality. The reason is that this punishment is unavailable in the last period. I therefore assume that quality is embodied in capital. The capital needed to produce one unit of high quality good in each period costs $c + \epsilon$. That which produces one unit of low quality good costs only $c$. The extra $\epsilon$ again represents the cost of unobservable managerial effort.

Buyers differ in their reservation prices. For any buyer, the reservation price for a unit of low quality is $\mu$ lower than that for a unit of high quality. In each period, the number of units $Q$ for which purchasers would be willing to pay $P$ if they believe them to have high quality is:

$$Q = a - bP. \tag{16}$$

Contractual payments cannot depend on the quality provided. With spot contracts, payments can only depend on the units received in each period. Payments to workers can depend on whether customers come back and continue buying at relatively high prices. Long term contracts between buyers and sellers can also specify payments if the pattern of purchases changes over time.

### 2.1. Spot Markets

Firms 1 and 2 install capacity $K_1$ and $K_2$ respectively. Under the informational assumptions discussed below, the cost to a firm of a unit of high quality capacity is $(c + \epsilon)$ and both firms decide to install only high quality capacity. The equilibrium capacity level is then equal to the Cournot level. This occurs because, as in Kreps and Scheinkman (1983), firms sell their entire capacity in the subsequent pricing game. In other words, firms expect to charge prices which clear the market when both sell their capacity. Therefore price equals $(a - K_1 - K_2)/b$ in both periods. Assuming the cost of capacity is $(c + \epsilon)$,

firm i's present discounted value of profits is then:

$$\left[(1+\delta)\frac{a-K_i-K_j}{b}-c-\epsilon\right]K_i, \qquad i=1,2, \qquad i \neq j \tag{17}$$

where $\delta$ is again the discount factor. In equilibrium each firm maximizes its own profits taking the other's capacity as given. This gives:

$$K_1 = K_2 = \left[a - \frac{b(c+\epsilon)}{1+\delta}\right]/3. \tag{18}$$

Given these capacities, the market clearing price is:

$$P_n = \left[\frac{a}{b} + \frac{2(c+\epsilon)}{1+\delta}\right]/3. \tag{19}$$

Profits are:

$$\pi = \frac{1+\delta}{9b}\left[a - \frac{b(c+\epsilon)}{1+\delta}\right]^2. \tag{20}$$

For this to be an equilibrium, firms must not wish to deviate when they choose quality, capacity or price. Given these capacities, cutting prices below (19) just reduces revenues since sales cannot increase. The following argument shows that raising prices is also not profitable. If the firm could ignore the capacity constraint, its price would equate marginal revenue to a marginal cost of zero. This price is lower than that given by (19) since that price equates marginal revenue to a positive marginal cost. This means that, except for the capacity constraint, the firm wishes to lower its price below that given in (19).

Consider now deviations in the level of capacity, taking quality choice as given. If firms know that they will charge the market clearing price, then (18) gives their optimal capacity. Kreps and Scheinkman (1983) have shown that (18) still gives the Nash equilibrium in capacities even when firms properly recognize that other capacities may lead to non-market clearing prices.

Before considering deviations at the quality stage and deriving the equilibrium cost of high quality capacity, I present my assumptions regarding consumer learning about quality. I assume that buyers initially expect high quality from any firm which charges a price given by (19). After purchasing, the buyers informally trade information about quality. They tell each other the quality of the units produced by each seller. I also let them tell each

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other which units of capital from a particular seller have low quality output.[13] Buyers are then willing to pay less for these units.

Consider a firm which installs a capacity given by (18) where some units are of low quality. The equilibrium then involves second period prices given by (19) for the units of good quality and prices given by

$$P_i = \left[ \frac{a}{b} + \frac{2(c + \epsilon)}{1 + \delta} \right] / 3 - \mu \tag{21}$$

for the units of low quality. At these price, the market clears in the second period. Customers want to buy exactly the units on offer at the posted prices. The firm thus gains no sales by cutting its price. It will also choose not to raise its price as long as the derivative of profit with respect to price:

$$K_i - bP_i$$

is nonpositive. Using the expressions in (19) and (20) this requires that:

$$\left[ a - \frac{b(c + \epsilon)}{1 + \delta} \right] / 3 \le b \left[ \frac{a}{b} + \frac{2(c + \epsilon)}{1 + \delta} \right] / 3 - b\mu$$

$$\mu \le \frac{c + \epsilon}{1 + \delta}. \tag{22}$$

Sufficiently high values of $c$ satisfy (22).

At these prices, and if the cost of high quality capacity is $(c + \epsilon)$, profits from having a fraction $\eta$ of low quality are:

$$\left[ (1 + \delta) \frac{a - K_1 - K_2}{b} - \delta\eta\mu - c - \epsilon(1 - \eta) \right] K_1.$$

Therefore, optimal $\eta$ is zero and quality is high as long as $\delta\mu \ge \epsilon$. Note that when $\delta\mu \ge \epsilon$ high quality is more profitable than low quality for any $K_1$ and $K_2$ such that the market clears. Moreover, an analogue of condition (22) ensures that the market does indeed clear in the second period for all plausible choices of $K_1$ and $K_2$. This means that the provision of high quality is a dominant strategy when $\delta\mu \ge \epsilon$ and customers initially expect high quality.

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[13] Capital need not represer. only physical capital. It can also represent human capital. High quality then represents a highly trained salesman who can help the customer. The customers then tell each other who the good salesmen are.

This analysis assumes that the incremental cost of high quality capacity is $\epsilon$. Yet, payments to workers cannot depend on the level of quality. However, they can depend on whether the firm continues to make the same sales at the price given by (19). In particular, suppose the seller pays its worker $\frac{\epsilon}{\delta}$ in period two if the firm charges the price given by (19) and obtains the same sales as in period one. Similarly it pays $\frac{\epsilon}{\delta}$ if it repeats its period one sales at any price above (21). By contrast, if the firm chooses to charge the price given in (21), it need not pay $\frac{\epsilon}{\delta}$ to the worker.

The difference between (19) and (21) is $\mu$. Therefore, if $\delta\mu$ exceeds $\epsilon$, charging (19) is preferable to charging (21) even if in the latter case one avoids the payment of $\frac{\epsilon}{\delta}$. Thus when $\delta\mu \geq \epsilon$ firms who succeed in providing high quality prefer to charge the high quality price (19). They then pay their workers a present value of $\epsilon$.

Suppose that the worker refrains from the necessary effort and provides low quality capacity. Then the firm would fail to sell at the price given by (19). The price given by (21) is the most that it can hope to earn. Moreover, by charging this price, it avoids the payment of $\frac{\epsilon}{\delta}$ to the worker. It therefore charges the price given by (21) and the worker earns only $c$.

Confronted with this environment, workers choose to provide quality. Moreover the cost (in present value terms) of supplying a unit of high quality is indeed $c + \epsilon$ while that of a unit of low quality is only $c$.

It is important to stress that the lost second period sales in the event the firm continues to charge (19) and has low quality are those to customers with low reservation prices. In particular, the lost sales are those to customers with reservation prices $R$ for high quality units below $\mu + \left[\frac{a}{b} + \frac{2(c+\epsilon)}{1+\delta}\right]/3$. Sellers are disciplined by buyers with low reservation prices.

Note that this equilibrium does not really require that quality be observable to top management at the buying company. Suppose that $R$ is the cost of an alternative input which serves the same role. Then top management of the buying company obtains efficient decisions from its buying personnel by giving them a choice. Management allows them to buy from either the original or the alternative source as long as they are willing to pay

their employer the price difference.

## 2.2. Two Period Contracts

The role of long term contracts is somewhat different here than in Section 1. As before these contracts have the objective of capturing rents. Now, however, rents do not increase by reducing customer mobility since customers typically remain with their supplier.

I thus assume that there is an initial period where a specific buyer can become attached to a specific seller. As a result of this attachment the buyer purchases his $B$ units from the seller in both periods.[14] Because the attachment reduces the need for the seller to woo this particular buyer, it frees the seller to spend more time selling to others. I thus assume that, if the buyer and the seller do become attached, the two sellers share the remaining demand equally when they both charge the same price. Unattached buyers pick sellers at random. Thus a seller who manages to attach himself to a buyer in the initial period has more sales. This assumption embodies the idea that long term contracts with buyers capture rents by increasing sales.

I also assume that the buyer who considers becoming attached to, say, seller one has a high reservation price. He is willing to pay more than the duopoly price given in (19) for even low quality units. This abstracts from one of the common reasons for vertical integration with imperfect competition. This standard reason is that integration leads to more efficient purchases of inputs.

In the initial period this specific buyer and seller one bargain. If they agree to a long term attachment the benefits are shared according to the bargaining strength of the two. If they fail to reach agreement the game proceeds with the spot contracts of Section 2.1.

When the buyer and seller one agree to a two period contract, the external market for both sellers shrinks. In particular, the number of units which can be sold at a price of $P$ if they are believed to be of high quality becomes:

$$Q = a - B - bP. \tag{23}$$

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[14] I could also consider attachments like those I considered in Section 1 which the buyer breaks probabilistically in the event he receives low quality. This would considerable complicate the analysis without affecting the main conclusion.

Since this outside market behaves like the market considered in Section 2.1 the equilibrium is analogous. Quality is high and the capacities for external sales, $K_1^e$ and $K_2^e$ equal their Cournot level:

$$K_1^e = K_2^e = \left[ a - B - \frac{b(c + \epsilon)}{1 + \delta} \right] / 3. \tag{24}$$

Given these capacities, the market clearing price is:

$$P_v = \left[ \frac{a - B}{b} + \frac{2(c + \epsilon)}{1 + \delta} \right] / 3 \tag{25}$$

The $B$ units sold by seller one to his attached buyer are of low quality. The reason is that the worker who builds the capacity for these units cannot be induced to bring forth the effort needed for high quality. His payment cannot depend on the level of quality. Moreover, since the buyer is attached, the payment cannot usefully be made contingent on whether these sales take place in the second period.

The question that remains is whether quality can be improved by letting these payments depend on how much outsiders are willing to pay for these unit in period 2. In other words, the seller might try to switch the units sold to the attached buyer for those initially purchased by an outside buyer. However, the outside buyer is likely to be leary of such a switch. Since quality is embodied in capacity and the outside buyer already knows that the units he received in period one were of high quality he will not welcome switches.

In particular, suppose that unattached buyers do not know the quality received by attached buyers. Then, they would rationally perceive the quality of the units originally sold to the attached buyer to be low. They would pay $\mu$ less for them than for other units. The reason this perception is rational is the following. Suppose outside buyers always regard these units as being of good quality. Then, the worker who builds the capacity to make these units knows that even outside sales will take place at a high price. His compensation does not usefully depend on whether these sales take place. He therefore provides low quality. Knowing this, the seller would always switch switch these units with those previously purchased by an outside buyer. Outside buyers would therefore only pay $\mu$ less for these units.[15] Since they do so regardless of actual quality, the compensation of

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[15] Of course the outside buyer would then learn their quality. This is of no help since the game ends after period two.

the worker cannot usefully be made contingent on the amount outsiders are willing to pay for these units. The quality of these units will be low.

Given that the $B$ units are of low quality, profits for the attached buyer and seller considered together are are:

$$B(1 + \delta) \left[ R - \mu - \frac{c}{1 + \delta} \right] + \frac{1 + \delta}{9b} \left[ a - B - \frac{b(c + \epsilon)}{1 + \delta} \right]^2 \qquad (26)$$

where the second term also equals the profits of firm 2. By contrast, if the buyer and seller rely only on spot contracts, buyer surplus is $B$ times the difference between $R$ and the market price. So total benefits of the two firms with spot markets are:

$$B(1 + \delta) \left( R - \left[ \frac{a}{b} + \frac{2(c + \epsilon)}{1 + \delta} \right] / 3 \right) + \frac{1 + \delta}{9b} \left[ a - \frac{b(c + \epsilon)}{1 + \delta} \right]^2 . \qquad (27)$$

The net benefits from the two period contract equal:

$$\begin{aligned}
\Phi &= B \left[ \frac{a(1 + \delta)}{9b} - \frac{c + \epsilon}{9} - (1 + \delta)\mu + \epsilon \right] + \frac{(1 + \delta)B^2}{9b} \\
&= B \left( \frac{P_n - c - \epsilon}{3} - [(1 + \delta)\mu - \epsilon] \right) + \frac{(1 + \delta)B^2}{9b} \qquad (28)
\end{aligned}$$

where use of (19) yields the second equality. Equation (28) has the following interpretation. Two period contracts are more attractive the higher is the difference between unit revenues $(1 + \delta)P_n$ and unit costs $c + \epsilon$ under spot markets. This is when the extra sales brought about by the contract are valuable. The benefit from capturing these rents is offset at least in part by the quality loss. This has an overall cost of $(1 + \delta)\mu - \epsilon$ per unit. The last term in (28) reflects that the duopoly's losses from the price reduction caused by integration are less than linear in $B$.

As in the repeated game context, contracts which bind the buyer may be attractive because they take rents away from one's competitors. This is clear in (17) whose second term equals the profits of firm 2. This term is unambiguously lower than the profits under spot markets given by (21). In contrast to my supergame model there is now also a social gain from these attachments. The two firms, perceiving a smaller external market lower price. It is of some interest to compare these two period contracts to spot markets from

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a social point of view. The loss is simply that quality is lower. The gain is $B/3$ more units are sold (this is the difference between$(K_1^e + K_2^e + B)$ and $(K_1 + K_2)$ leading to a reduction in market price of $B/3b$ (this is the difference between $P_n$ and $P_v$). The total gain in consumer plus producer surplus is therefore:

$$
\begin{aligned}
\Gamma &= \left( \frac{1+\delta}{3} \left[ \frac{a-B}{b} + \frac{2(c+\epsilon)}{1+\delta} \right] - c - \epsilon \right) \frac{B}{3} + \frac{(1+\delta)B^2}{18b} - [(1+\delta)\mu - \epsilon]B \\
&= \left( \frac{P_n - c - \epsilon}{3} - [(1+\delta)\mu - \epsilon] \right) B - \frac{(1+\delta)B^2}{18b}
\end{aligned}
\tag{29}
$$

where the second equality follows from (19). The expression in (29) is smaller than that in (28). So, the net social gains from becoming attached are strictly smaller than the private gains. Thus equilibrium contracts of the type I have considered can be socially detrimental.

Before closing this section, it is worthwhile to go through a numerical example. This example shows that it is possible both to meet all the conditions necessary to sustain high quality spot market equilibria and for two period contracts to be attractive from a private point of view. To some extent these requirements conflict. Spot markets provide high quality if $\delta\mu$ exceeds the cost of quality $\epsilon$. On the other hand, a large difference between $\mu$ and $\epsilon$ makes attachments unattractive. Firms may become attached nonetheless because the attractiveness of two period contracts increases as $a$ rises. Increases in $a$ lead to higher prices without affecting the conditions for the existence of high quality equilibria.

I assume that $\epsilon$, $b$ and $B$ equal 1.0, $\mu$ equals 1.5, $c$ equals 10, and $\delta$ equals 1.0. Then, condition (13) is satisfied as is the condition that requires that $\delta\mu$ be larger than $\epsilon$. For $a$ greater than or equal to 13.5 two period attachments are worthwhile. They become socially worthwhile only if $a$ also exceeds 15.

As in Section 1.3, outright integration can sometimes improve on exclusive sales contracts like those I have studied. In particular, if a top manager who is giving control over all assets can make quality verifiable at cost $Q$, it may be worth hiring such a manager. What makes this agent a top manager is precisely that he is given control over all assets. This manager then ends up using a socially inferior (to spot markets) mechanism for elliciting high quality.

## 3. Conclusion

Ever since the important work of Coase (1937) economists have generally viewed the internal organizations of capitalistic firms as benign. Even Williamson (1975, 1985), who concedes that vertical integration sometimes reduces competition, asserts that the main purpose of integration is to reduce "transactions costs."

This paper suggests a less sanguine view. Whether the organization of firms is socially helpful is an empirical question. It is not a question economists should feel capable of answering on a *priori* grounds alone. Since little other information on the actual functioning of institutions exists, we should play close attention to the comments of managers.

In this paper I have taken a particular interpretation of the managerial displeasure with internal transactions reported by Eccles and White (1988). I have viewed this displeasure as arising from the inability of internal transactions to give satisfactory results when contracts are incomplete. Alternative readings may be possible. Perhaps managers dislike intrafirm transactions only because they cloud managerial compensation. Because transfer prices are to some extent arbitrary, the existence of intrafirm transactions makes the profits reported by profit centers less meaningful. This may adversely subject manager wages to risk. Holmstrom and Tirole (1987) use an analogous argument to explain GM managers' dislike of centralized procurement. This story is not complete. Firms must have some reason for exposing their employees to additional risk. One possibility, which seems particularly plausible in the case of centralized procurement at GM, is that firms wish to capture rents. This is very similar to the story pursued here. There may be alternative, efficiency reasons for exposing the managers to this risk. They await empirical discovery.

Information gathered from managers may also illuminate whether organizations are particularly effective at inducing investments in specific capital. This is the idea stressed by Williamson (1975, 1985) and Grossman and Hart (1986). One open issue is whether manager unhappiness with integration is less severe when firms are very concerned with inducing specific investments. Similarly, we do not know whether monopolistic conduct in product markets exacerbates this unhappiness. My "rent capture" theory of integration predicts that it does.

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The theory presented here may also be able to explain differences in the organization of firms accross nations. Japan and Korea both have relatively more intrafirm transactions than the US. In Korea large conglomerates dominate all industries. In Japan *keiretsu* firms carry out many transactions with other members of their own *keiretsu*. Perhaps the korean and japanese cultures, which extoll the team spirit, make it possible to maintain higher quality in intrafirm transactions. This reduces the organizational cost of rent extraction through integration.

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